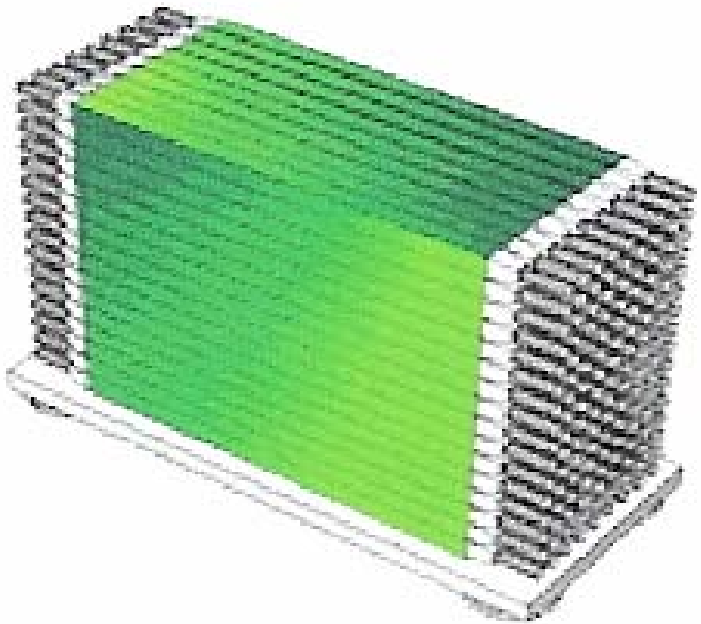
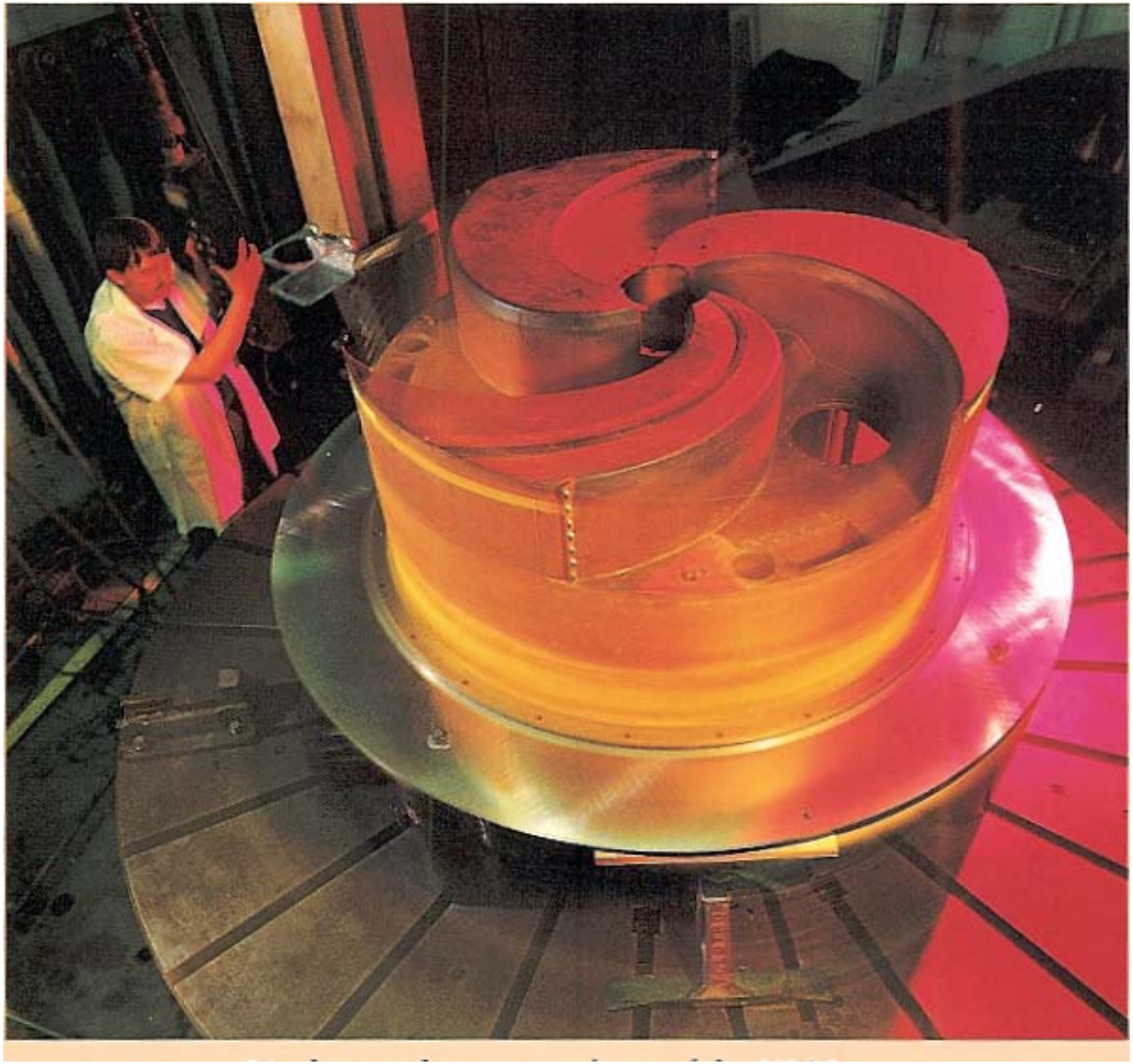
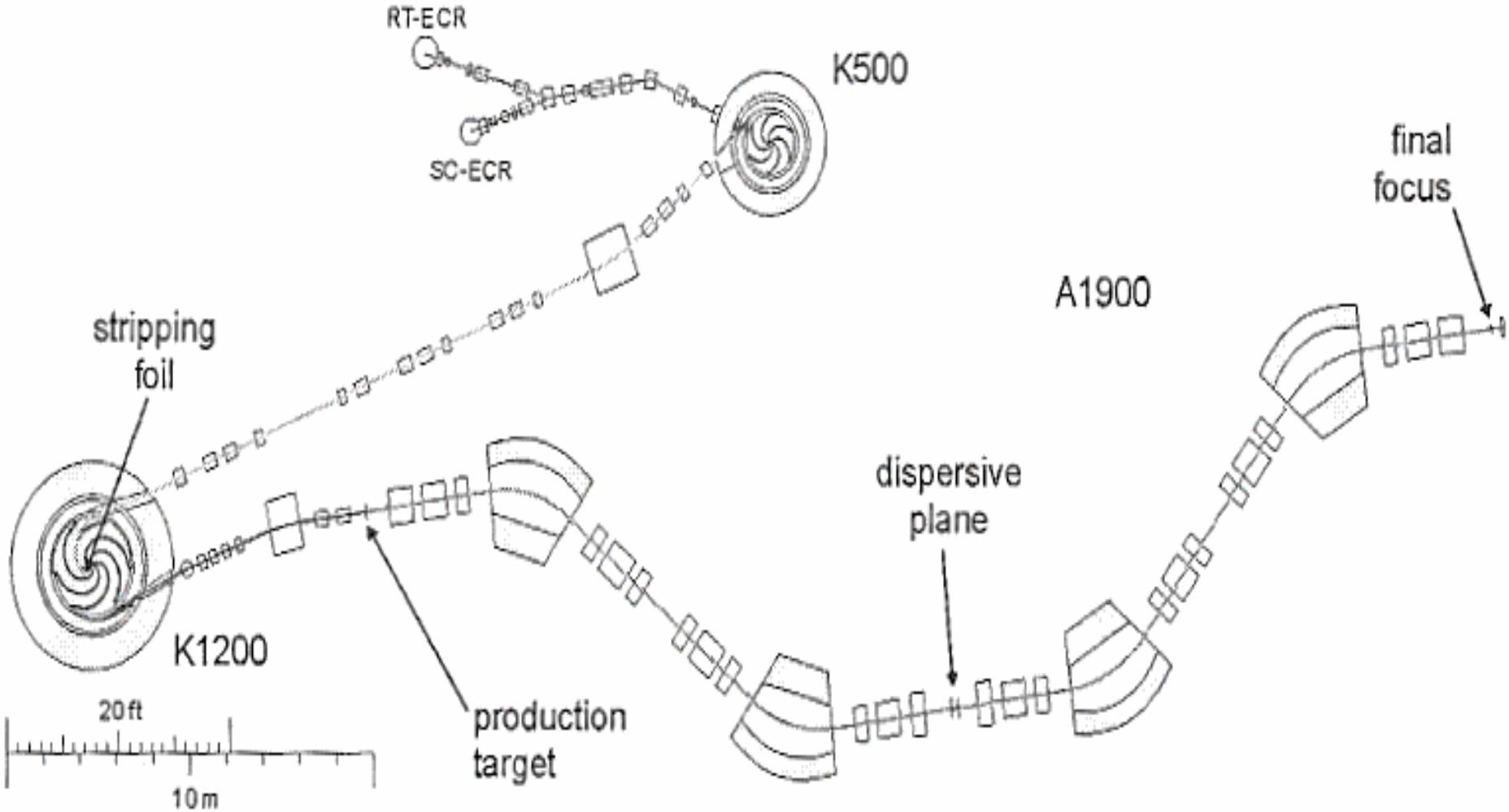
MoNA: A Modular Neutron Array



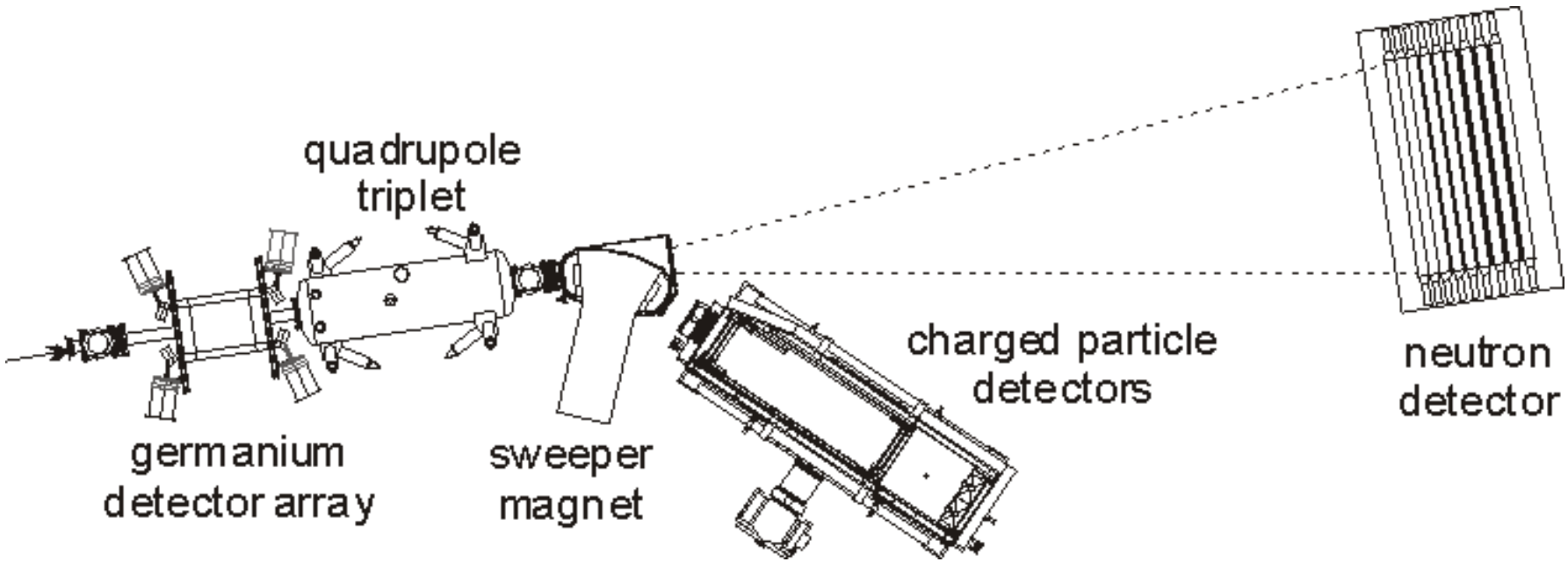
Ruth Howes

Ball State University




RT-ECR
SC-ECR
K500
final
focus
A1900
stripping
foil
dispersive
plane
K1200
20 ft
10 m
production
target

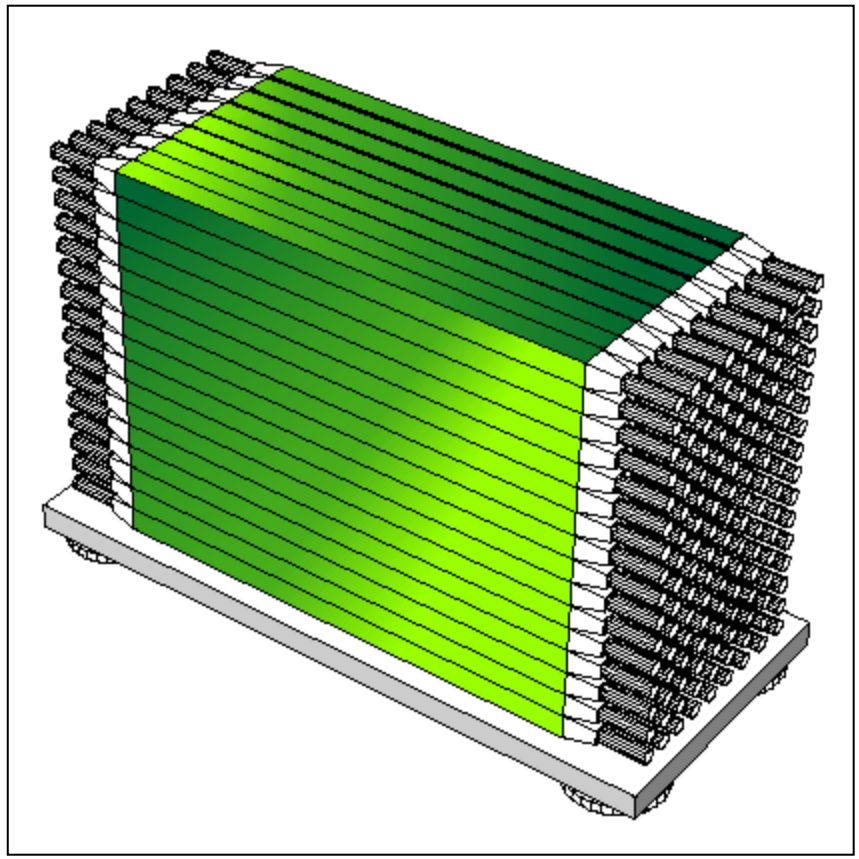
Placement



MoNA will be located in high bay area at the NSCL. This will allow it to be used in conjunction with other detectors at the laboratory.

The MoNA Detector

- The detector will consist of 144 individual detector modules.
- The modules will be arranged in a series of vertical planes.



Detector Modules

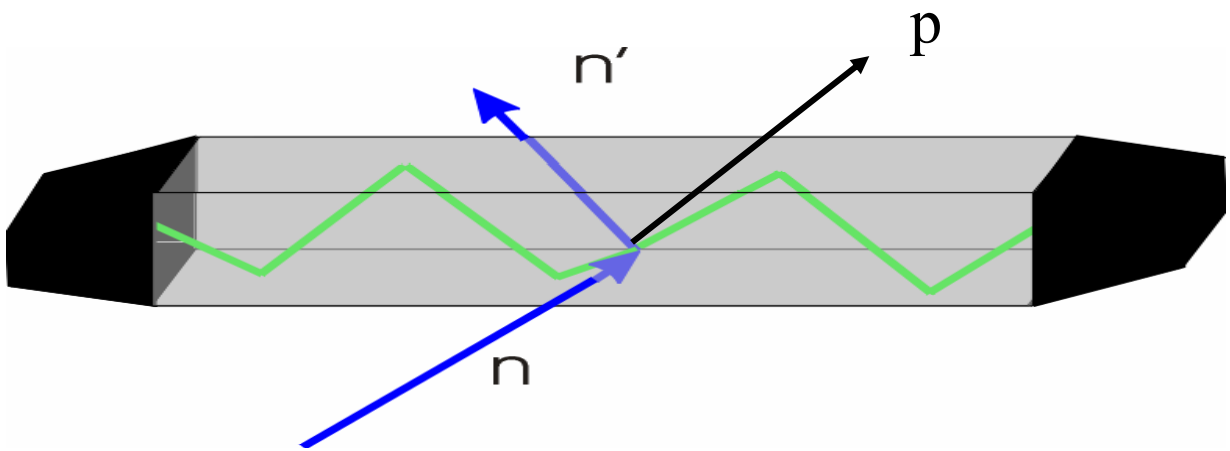
- Each module is a 200 x 10 x 10 cm bar of plastic organic scintillator material.
- At each end a photomultiplier tube is mounted to light guides.

Phototube Assembly

This image shows a cutaway view of the photo-multiplier assembly for one of the detector modules

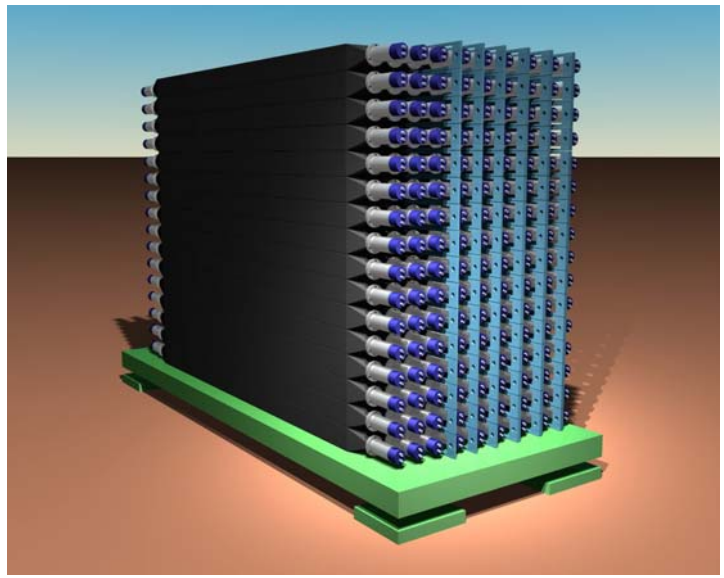
Module Operation

- Neutrons strike protons in the plastic scintillator.
- The recoiling protons excite the atoms in the plastic which give off light.
- The light travels to the ends of the detector bar.
- By using timing differences the position of the neutron hit is determined.

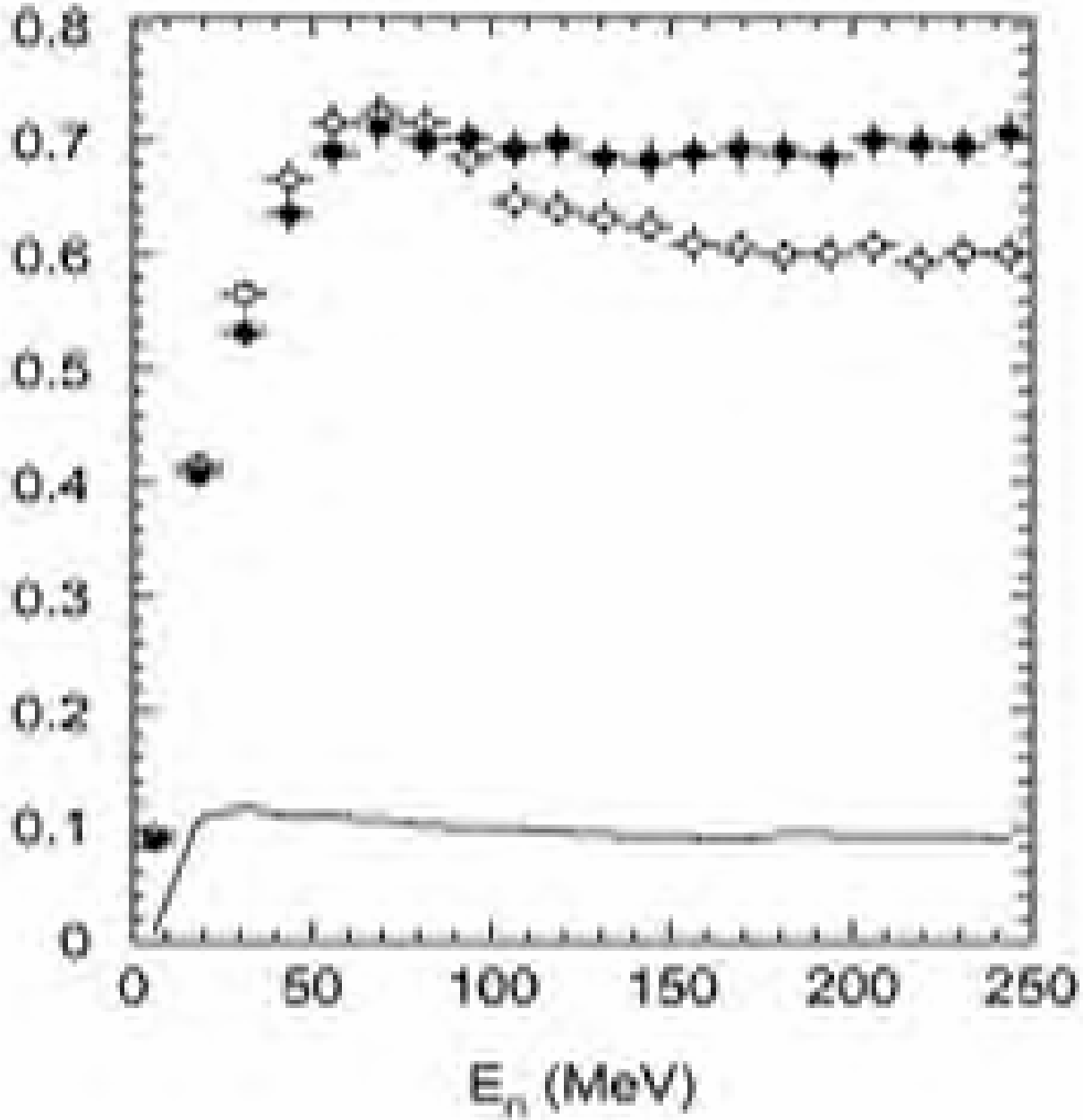


Passive Converters

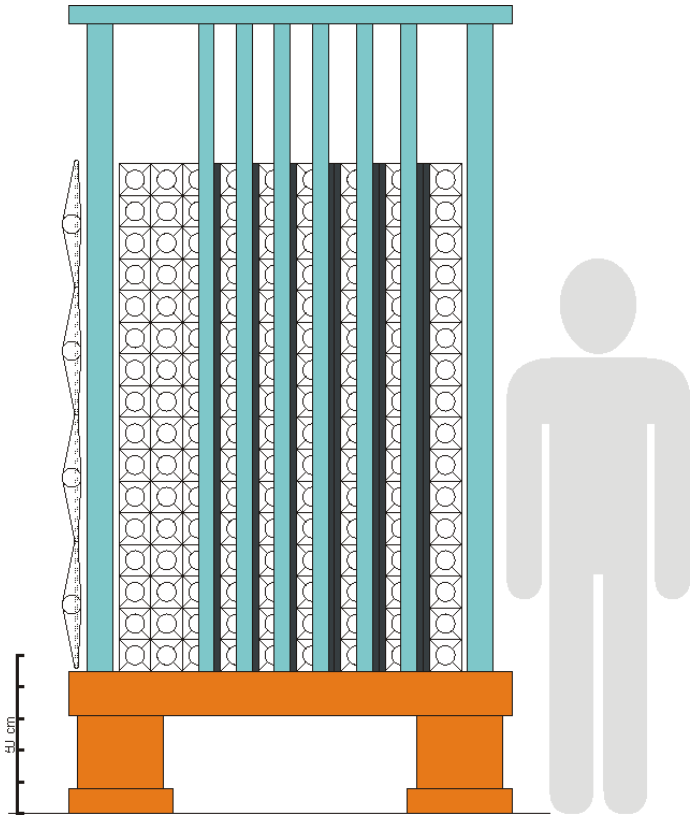
- Iron sheets are used as passive converters to increase the neutron detection efficiency. Nuclear interaction lengths of 17 cm
- MoNA will be up to 50 times more efficient than current neutron detectors at the NSCL.

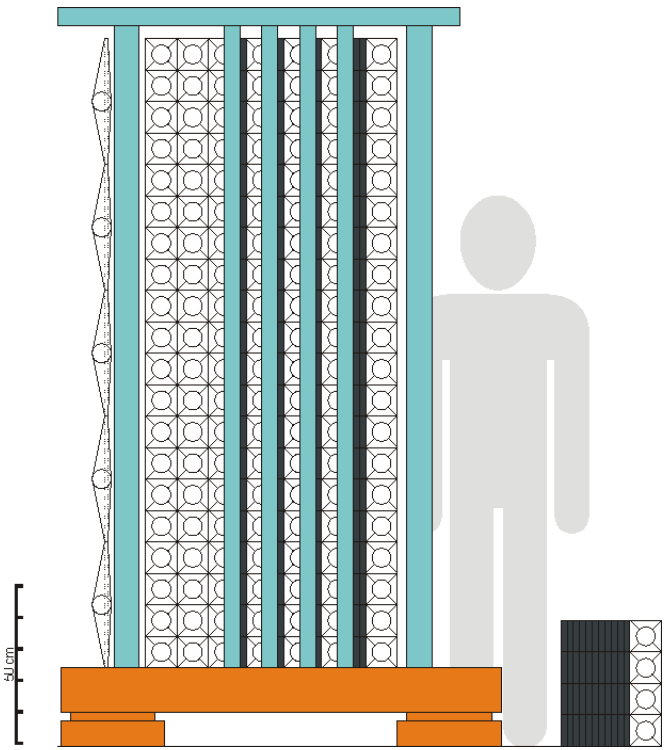


The iron sheets are shown here in light blue between the back six layers of the detector.

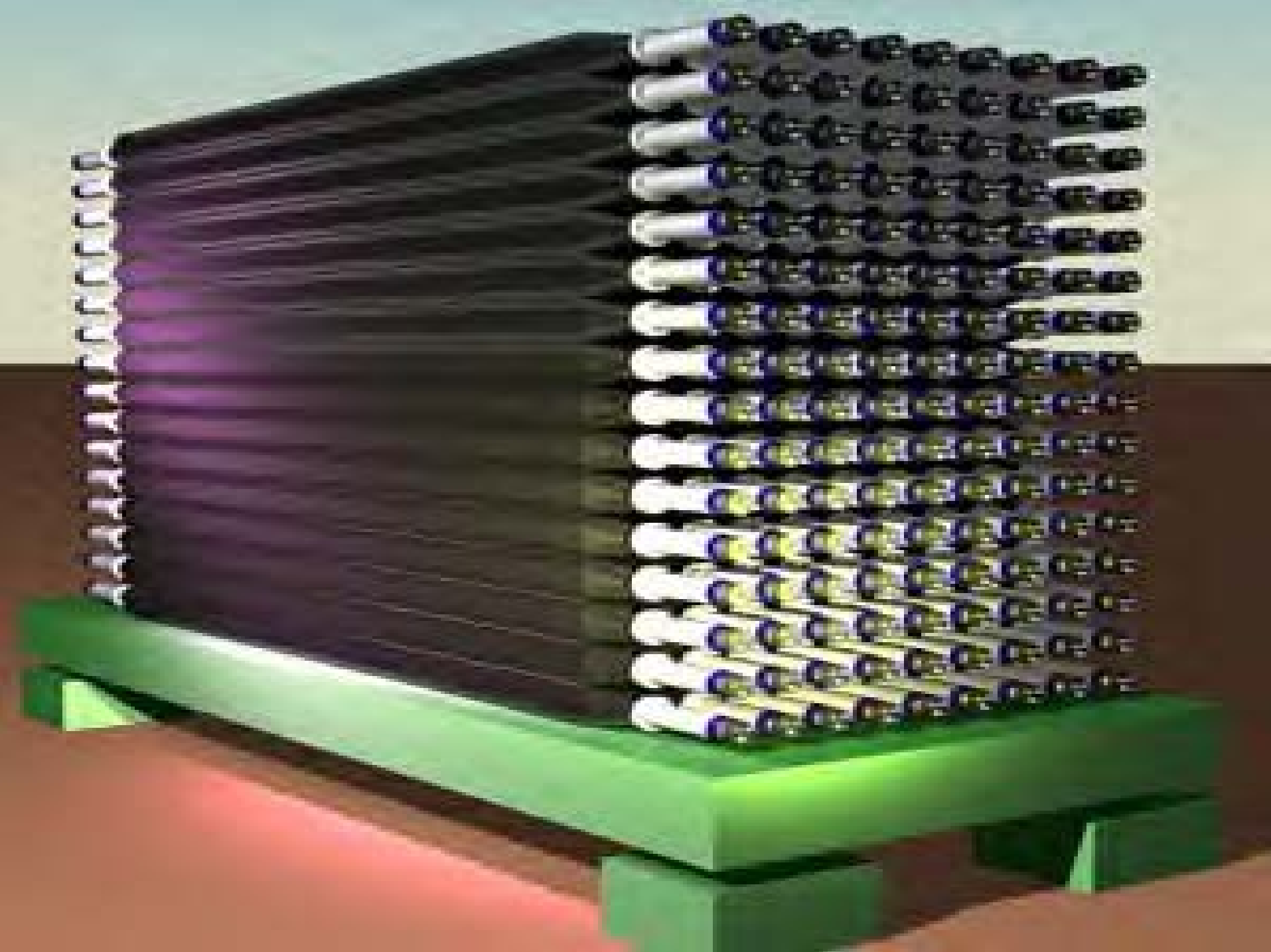

0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
50
100
150
200
250
E_n (MeV)

Modular Design





The modular design allows the detector
to be reconfigured to optimize performance.



How MoNA is Being Built

Eight undergraduate institutions each with grant for about $100,000.

One professor plus student or students at each.

Design primarily at Michigan State.

Detailed instruction Manual.

Each institution responsible for calibration of 16 modules.

Completed modules transported to NSCL for Assembly.

Team effort with collaboration meetings welcoming undergraduates.

Opportunity for professor at a UI to take sabbatical at NSCL.

MoNA Collaborators

Michigan State
Florida State
Ball State
Central Michigan
Concordia College
Hope College
IU – South Bend
Millikin University
Western Michigan
Westmont College


COLDWATER


Truck Rental
Local · One Way
Do-it-Yourself Moves
Business Rentals
1-800-GO-
NSKE
www.Penske
m
Special Savings for Members
ABERCROMBIE
66749

Problems with Undergraduate Research in Nuclear Physics

Undergraduates are not flexible in time.

Research is not done on the undergraduate campus.

difficulty with local funding

difficulty with recruiting students

low profile in undergraduate institution.

Physics often too hard for beginners.

MoNA's Advantages

Work done at the undergraduate institution

Undergraduates have

- ability to work around courses
- local funding
- high local profile
- opportunity to meet and work with students from other institutions

Professor has

- interaction with first rate nuclear physics
- funding & papers for P&T

Detector Development is IDEAL for

involving undergraduates in research!!!